LOOK ACADEMIC PUBLISHERS
OPEN ACCESS

INTERNATIONAL JOURNAL OF ENVIRONMENTAL & SCIENCE EDUCATION
2016, VOL. 11, NO. 17, 9657-9668

Geodynamical Nature of the Formation of Large Plates of Platforms, Jointed in North Caspian Oil and Gas Basin

Nassipkali Seitov, and Gulmira P. Tulegenova

Kazakh National Research Technical University after K. I. Satpayev, Almaty, KAZAKHSTAN.

ABSTRACT

This article addresses the problems of tectonic zoning and determination of geodynamical nature of the formation of jointed tectonic structures within the North Caspian oil and gas basin, represented by Caspian Depression of Russian platform of East European Pre-Cambrian Craton and plate ancient Precambrian Platform stabilization and Turan (Scythian-Turan) plate of Cimmerian (Mesozoic) folding. It is stated that the principle of zoning according to time of the final phase of folding in practice is used more often, although this principle was established by geosynclines concept, which was a major paradigm of fixism geotectonic school. It is noted that the main reason of the demand for the fixists principle of zoning, while ignoring main provisions of a more progressive mobilistic concept of plate tectonics, is explained by the inability to discover the interdependence of folded structures of the regional continents formation and isometric forms with closing of ocean basins, comparable with modern (Mesozoic-Cainozoic) oceans. Although almost all the researchers on this region associates the establishment of the abovementioned plate structures with the development of a hypothetical large oceans of the Paleozoic – Paleo-Uralian ocean and Paleo-Tethys Ocean, respectively. The article specifies the divisiveness of such an interpretation, as the results of research allow us to defend the idea of the regional character of the plate tectonics in pre-Mesozoic stage of development of the planet. From such point of view, the Paleozoic history of the formation of Caspian Depression platform cover and folded basement of Turan (Scythian-Turan) plate cannot be associated with the global plate tectonics.

KEYWORDS
North Caspian; geotectonic zoning; ancient platform; Caspian Depression; young platform.

ARTICLE HISTORY
Received 8 May 2016
Revised 20 July 2016
Accepted 3 August 2016

Introduction

It is well known that the identification of the geodynamical nature of formation of tectonic structures and determining of their prospects for the discovery of mineral deposits depend on the principle of tectonic zoning, anyway (Pilifosov, Vocalevskij & Vasil'ev, 1996; Seitov & Arshamov, 2015). Before the emergence of the global tectonics ideas in the second half of the twentieth century and the opening of a number of oil and gas fields at the bottom of the Caspian Sea at the beginning of the new century, the issues of zoning of the reviewed North Caspian region did not presented a great problem. Inasmuch as the tectonic development of the Caspian Depression and Turan (Scythian-Turan) plate, contiguous in the northern part of Caspian Sea, was considered as separate, as it have nothing in common, except oil-and-gas content inherent to both

CORRESPONDENCE Gulmira P. Tulegenova ✉ tulegenova16@mail.ru

structures (Antipov et al., 2015; Daukeev et al., 2002). The need for "conjoint consideration" of structures in this region and ascertainment of geodynamical nature of formation of "near-border structures" of the two plates have began with the discovery of hydrocarbon deposits in the Caspian Sea. Even the appearance of the phrase "North and Middle Caspian" in geological literature is caused by the discovery of oil fields at the bottom of marine basin and the need for search new objects in this region – in the suture zone of the Caspian Depression of ancient East European platform and Turan (Scythian-Turan) young epi-Paleozoic plate. The need for exploration and discovery of new oil and gas fields in the northern part of the Caspian Sea determines the importance of issues relating elucidation of the geological history of the formation of the abovementioned major tectonic elements of the earth's crust. These elements are contiguous within the reviewed region, where potential oil and gas fields of the regional and local scale should be.

Now, almost all of the researchers of North Caspian region conduct a tectonic zoning of this area of the earth's crust, where young and ancient platforms join, from the perspective of the main provisions of lithosphere plate tectonics (Kuandykov & Matloshinskij, 2015; Kusanov, 2015). Thus, not only the geotectonic nature of young Turan (Scythian-Turan) epi-Paleozoic plate is considered, but also a geotectonic nature of the formation of the sedimentary cover of the Caspian Depression, which is part of the East European Craton of Precambrian stabilization. There is no doubt that crucial role in the formation of the sedimentary cover of Turan (Scythian-Turan) young plate belongs to global plate tectonics since the Mesozoic and discovery of Mesotethys, which formed Jurassic-Neogene sequences of the sedimentary cover of the plate as a whole, and its "North Caspian edge", in particular. As for the geodynamical (tectonic) nature of the Caspian Depression, it should be regarded as continental ancient structure, in the formation of which the role of plate tectonics is absent. Following conclusion is suggested:

a) the discrepancy between the configurations of the Caspian Depression and hypothetic Paleo-Uralian Ocean, whose opening and closing are expected to form Phanerozoic (Neoproterozoic-Phanerozoic) depression cover;

b) results of an ophiolite zones study of one of the authors of this article conducted in the southern part of the Ural Paleozoic folded structure (Mugodzhar Hills) and throughout the Kazakh folded region as a whole, showed that the plate tectonics in the Paleozoic stage of development of the planet had a regional character. Thus, opening and closing of the Ural-Mugodzhar micro oceans could not affect the formation of the cover of Caspian Depression, which is characterized by solid size and isometric configuration. The latter fact, i.e. the idea of a regional scale of plate tectonics in the Paleozoic (Neoproterozoic-Paleozoic) stage of development of the planet is a contribution to the development of geography, as opposed to its global scale.

Literature Review

Before the advent of plate tectonics ideas, geotectonic nature of Caspian Depression, as well as Turan (Scythian-Turan) plate traditionally have been viewed from the perspective of the geosynclinal theory and, accordingly, tectonic zoning of these structures was based on the principle of determining the time of the final phase of folding (Avrov et al., 1962; Bulekbaev et al., 1967; Gareckij et al., 1962). A second group of researchers (Ajzenshtdat et al., 1967; Kunin & Sopozhnikov, 1964; Bulat, 2016)

explains the geotectonic nature of the formation of near-border flanks between the ancient and young platforms, where the largest hydrocarbon deposits are concentrated, by the manifestation of intercontinental rifting or aulacogens deposits in continental crust. With the appearance of plate tectonics ideas, many researchers have changed their views "on mobilistic way" and have begun concentrating their palinspastic constructions on the lateral movement of huge lithosphere plate on huge distances (Amelin et al., 2015; Zonenshajn, Kuz'min & Natapov, 1990; Pilifosov, Vocalevskij & Vasil'ev, 1996). These researchers associated the formation of Paleozoic structures, including the structures of the North Caspian region, with the interaction of the East-European-Turan, Kazakhstan and African continental plates and the Ural (Ural-Tien Shan) paleocean and Paleo-Tethys. The next group of researchers (Zholtaev & Kuandykov, 1999; Nursultanova, 2003; Hain & Lobkovskij, 1990) concedes the influence of so-called "two-levelplate tectonics" in the development of Paleozoic structures of the region, somehow trying to link the formation of regional folded structures of the continent with a global plate tectonics in the Paleozoic. According to this view, laterally directed movement of the lithosphere tectonic blocks occurs at different levels and at different scales – globally on the asthenosphere level, on a regional scale – on the surface of the so-called crustal asthenosphere. Kazakh scientists (Avdeev, 1984; Seitov, 2008a, 2008b) defend the regional nature of plate tectonics in the Paleozoic (Neoproterozoic-Paleozoic) at its global manifestation in the Mesozoic-Cenozoic, based on the study of ophiolitic zones of Paleozoic, which shows the existence of the oceanic crust in the geological past of the Earth. Such a suggestion is made as a result of systematic and comprehensive study of the characteristics of ophiolitic zones of Kazakh fold region of Central Asian Orogenic Belt. It is explained as a geological object from the perspective of the evolutionary nature of the planet development. From such a standpoint, the history of the formation of Paleozoic platform cover of the Caspian Depression and Paleozoic folded basement of Turan (Scythian-Turan) plate cannot be connected with the opening and closing of such hypothetical major Paleozoic oceans, as Paleo-Uralian Ocean and Paleo-Tethys, respectively.

Aim of the study

Consider tectonic zoning and geodynamical nature of tectonic structures in the North Caspian region.

Research questions

What does "passive margin" mean?

Method

"North Caspian" is the subject matter of this article. It covers the southern piece of the East European Craton, presented by the southern part of the Caspian Depression, and the northern part of epi-Hercynian Turan (Scythian-Turan) plate edging it from the south and southeast. Above-noted edge is represented by a continuous band, which crosses the Caspian Sea from the north-west to south-east along the azimuth of 110°-120° (Figure 1). The width of this band ranges from 60 to 100 km. One of the researchers of the North and Middle Caspian Murzin Sh. M. calls it "Bozashinsk-Mangyshlak elevation system" (Murzin, 2010), while a group of Kazakh oil geologists distinguishes this band as "Bozashinsk diastrophism system" of North-Caspian uplift in the Paleozoic (Marabaev et al., 2005). According to Murzin Sh. M., "East-Manychesk-

South-Mangyshlak system of downfolds" (Murzin, 2010) extends along this band or "Mangyshlak diastrophism group", according to Marabaev Zh. N. et al. The latter also belongs to the Turan (Scythian-Turan) epi-Hercynian plate, and it is already regarded as a part of the Middle Caspian.

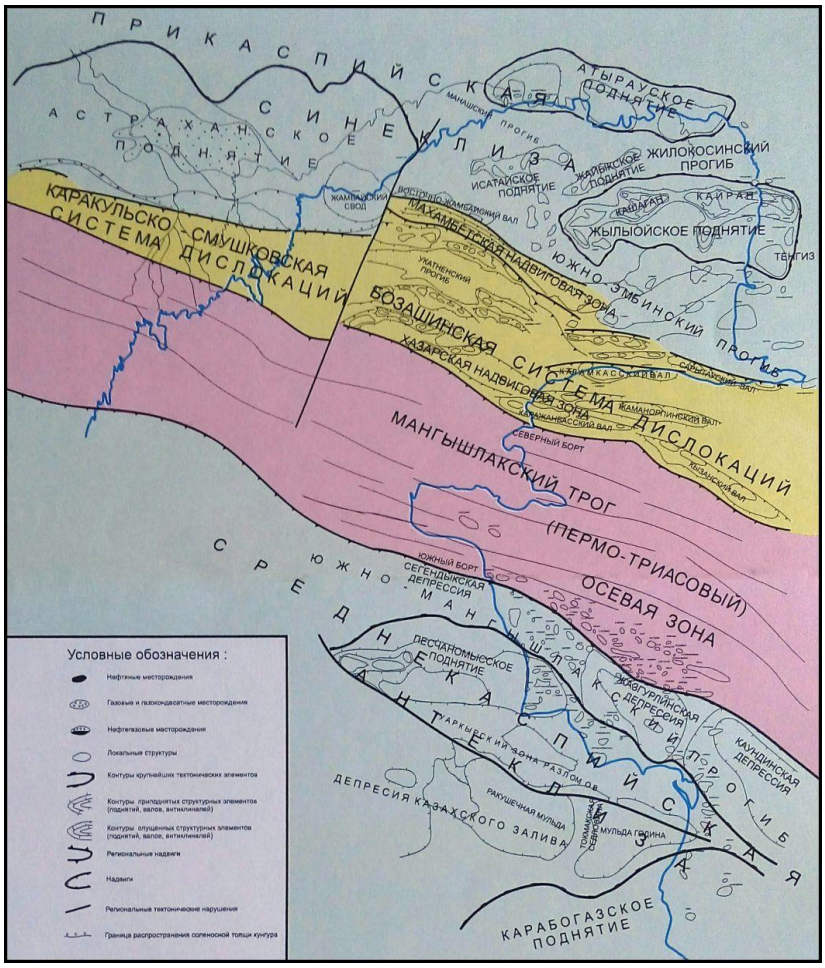

Figure 1. The structural-tectonic map of the Caspian Sea (Kazakhstan part) and adjacent territory of the Paleozoic complexes (Map taken from (Pilifosov et al., 1996)

Another specific structure "bear against" the area of junction of two large plates with different time consolidation (ancient Caspian Depression and young Turan plate) within the North Caspian by its western continuation. Pilifosov V. M. et al. (1996) call it "South-Emba elevation", or "South-Emba downfall (rift)", according to Marabaev Zh. N et al. (2005) and Nursultanova S. A. (2003). This narrow zone has a width of 30-35 km, stretches from north-east to south-west for a distance of 500 km, and its southwestern extension "enters" the Caspian Sea. Its specificity lies in confinedness to the south-eastern edge of the ancient Caspian Depression. However, the lower part of the Paleozoic section of the edge, as opposed to the central regions of the syncline, is heavily disturbed. That is why this flank structure is considered by many researchers separately from the Caspian Depression.

Dealing with problems on the correctness of the chosen principle of tectonic zoning of the North Caspian region and clarification of the geodynamical nature of the formation of structures is carried out by analysis and synthesis of existing views on these issues. They are also generalized in accordance with the idea of the regional nature of plate tectonics in the Paleozoic (Neoproterozoic-Paleozoic) stage of planet development in its global manifestation in the Mesozoic-Cenozoic.

Data, Analysis, and Results

The main goal of the study of North Caspian region is to find out the features of the geological structure of this region due to the potential oil-and-gas content of sedimentary cover sections of the platforms. Achieving this goal is impossible without finding geotectonic and geodynamical nature of the formation of large tectonic elements of the earth's crust, which have potential oil and gas bearing structures. These are the Caspian Depression of Precambrian stabilization and Turan (Scythian-Turan) epi-Paleozoic plate, as well as flank structures, which "join them".

It is known that tectonic zoning issues play a crucial role in regional studies. Well-chosen principle of tectonic zoning and consideration of studied area as a part of one or another type of major structural elements of the earth's crust determine the correctness of the results of regional studies in many cases. This also applies to petroleum geology. Hydrocarbon deposits are usually associated with the platform cover, which structurally develops differently, depending on the age of the folded basement.

It is well known that tectonic zoning and allocation of regional structures of the earth's crust are based primarily on the features of the geological history of reviewed area of the earth's crust, identified as a result of geological and geophysical studies. There are several principles of tectonic zoning, based on geological history of the object. In practice, two most frequently used principles are:

– zoning according to time of the final phase of folding;

– zoning according to the time of transition of the oceanic structure of the geological past of the planet in the continental structure.

This first principle is used in practice since the time of recognition of the leading role of fixism direction in geotectonics, and geosynclines concept served as the theoretical basis of it. The second principle of zoning was implemented in practice due to the world geological community recognition of paradigmatic role of mobilistic direction in geotectonics, which is based on the provisions of the concept of plate tectonics.

The second principle of zoning, which based on mobilistic principles, is supposed to be more preferable, inasmuch as hardly anybody doubts in the leading role of large horizontal (lateral) movements of the lithosphere blocks in the formation of tectonic structures of the earth's crust of the last the Mesozoic-Cenozoic stage of development of the world. However, the principle of zoning according to time of the final phase of folding was successfully used under the leadership of geosynclines concept in the development of continental structures. Now it is commonly used in practice and in many cases, it even remains a prior and widely accepted principle. The phenomenon of "vitality" of the principle of zoning, based on fixism ideas, probably, can be explained for two reasons:

1) the final phase of folding, as is well known, corresponds to the time of tectonic and magmatic activity extinction of the region and the transition of the movable area (this area used to be called “geosynclinal” area) to the platform. Such an understanding of the essence of the process shows that the time of completion of tectonic and magmatic activity plays a crucial role in this case, while issue of orientation of the tectonic stresses in space and time has a secondary role. In such case, newly formed platform becomes subjected only to epeirogenic (oscillating) movements up and down, without substantial disturbing the internal structure of the earth's crust (lithosphere) part, which is exposed to these movements; and it is very important for the formation of powerful and lightly deformed sequences of sedimentary rocks, which are associated with the formation of hydrocarbons deposits.

2) it is impossible to use the main provisions of plate tectonics in its present (Mesozoic-Cenozoic) global manifestation in order to decipher the nature of pre-Mesozoic geodynamic structures; as the link between the closing of the vast ocean and the formation of regional folded structures of the continents is very difficult or even impossible to identify.

At the same time, many scientists trying to zone the studied tectonic structures of the continents in practice from the perspective of the global plate tectonics in relation to the pre-Mesozoic structures of continental crust. Such zoning schemes are often poorly supported by factual data and are hypothetical, because they are elaborated not on the basis of careful analysis and synthesis of the material, but on the desire of the authors “to keep pace with the times” and keep up new trends in geological science.

The foregoing applies mainly to scientists studying the folded basement of ancient and young platforms on a modern denudation sheet and exposing on the surface. We can note with regret that researchers of covered by platform (sedimentary) cover plate structures also tend to use the global plate tectonics in their studies. Although, because of “inaccessibility”, folded complexes with a thick cover often do not have the information required for the formulation of conclusions, which are derived as a result of interpretation of the data from the perspective of global tectonics. This observation is especially useful when we are talking about the Precambrian-Paleozoic history of the planet.

Geodynamical nature weakly disturbed platform sedimentary cover within continents is difficult to associate with the plate tectonics, since the section of sedimentary rocks is peculiar only to the passive continental margins of currently existing opening oceans. “The transition of an ocean into continent” should be carried out as a result of the closing of pre-existing ocean. Therefore, mentioned sedimentary complex should undergo severe deformation under compression, which is inherent to convergent boundaries of lithosphere plates. However, with the advent of plate tectonics theory, almost all researchers of the North Caspian region are trying to explain the geodynamical nature of the formation of the sedimentary cover of not only epi-Paleozoic Turan plate, but also the ancient Caspian Depression by the global manifestation of plate tectonics.

Some researchers of Caspian Depression tend to associate the formation of weakly disturbed Paleozoic (Neoproterozoic-Palaeozoic) sedimentary cover of the syncline with existed hypothetical large oceans in the Paleozoic (Late Precambrian-Paleozoic) stage of development of the planet. Thus, a group of Kazakh oil scientists, who drew a map of Kazakhstan's oil and gas potential (Daukeev et al., 2002), pointed out that the

sequences of the syncline platform cover, deposited at least in the Devonian period of the Paleozoic, were formed under conditions of passive margins. “Continental margins are seen as the primary global zones of oil and gas formation and accumulation”, declares researchers (Daukeev et al., 2002), but they do not take into account the impossibility of preserving passive margins complexes within the continent in the form of slightly deformed sedimentary cover. Thought of this group of scientists is repeated by the next group of Kazakh scientists, claiming that, “from the perspective of plate tectonics, two important stages are differentiated in history of development of the region. The first stage is Paleozoic, from Devonian to Permian, when there were three huge lithosphere plates (East European-Turan, Kazakh and African), separated by two paleo-oceans (Ural-Tien Shan and Paleo-Tethys). The second stage is Mesozoic-Cenozoic, when instead of two lithosphere plates (East European-Turan and Kazakh plates) one lithosphere plate had formed, bounded by Meso-Tethys on the south” (Zholtaev & Kuandykov, 1999). The same idea is expressed by the Russian colleagues, who associate the geological nature of the studied region represented by the Caspian sedimentary basin “with the development of two global paleo-oceanic systems – Paleo-Asian or Ural-Siberian and Paleo-Tethys” (Amelin et al., 2015). In one of the last works of the Kazakh geologists, it is noted that, “Depression (referring to the Caspian Depression, author’s note) corresponds more with the embedded remains of the Paleozoic ocean by the nature of the changes in its facies. In consequence of the position as pronounced gulf of the near a platform, the ocean had preserved from the conversion, during the collision between two Hercynian paleo-oceans: Uralian in the east and the Paleo-Tethys in the south” (Kuandykov & Matloshinskij, 2015). Another Kazakh researcher Zh. K. Kusanov supposes that the Riffean-Paleozoic stage of syneclise development occurred “on passive margin of the Russian Platform” (Kusanov, 2015). Group of Russian scientists, allowing the existence of the continental ditch basin of the late-Artinskian-Kungurian time, admits “the presence of intermittent connection of the ditch and the ocean” (Bulekbaev et al., 1967). One of the most active researchers of the Middle and North Caspian Sh. M. Murzin believes that “in the Middle Devonian time in place of Caspian depression a disclosure of shearing rifted basin (pull-apart type) occurred...», that «was surrounded by passive continental margins” (Murzin, 2010).

Even the abovementioned small list of publications shows a variety of opinions about the geodynamical nature of the formation of the Caspian Depression. However, the phrase “passive margin” is common to all of these ideas. It turns out that the passive margins may exist only on the margins of one or another ocean (Amelin et al., 2015; Daukeev et al., 2002; Zholtaev & Kuandykov, 1999), but they also may be embedded remains of the Paleozoic ocean (Kuandykov & Matloshinskij, 2015), or passive margin of not hypothetical ocean, but strictly of Russian Platform (Kusanov, 2015). They may even represent intercontinental ditch (Antipov et al., 2015), or the framing of the continental rift (Murzin, 2010).

In our understanding, the phrase “passive margin” should be used in relation to the margins of currently existing (developing) oceans, as continental “margins” cannot exist as a tectonic structure. Another thing is the geological assemblage of passive margins of the oceans. Within the continents, they should be present only in the strongly deformed (contorted into folds) form, as even hypothetical Paleozoic oceans without their closing and creating a tangential stress cannot turn into continents.

If the slightly deformed cover of an ancient platform within the continent cannot be logically parallelized with passive margins of opening oceans, then, from a factual point of view, it is unacceptable to associate its formation with the closure of hypothetically large Paleozoic oceans. However, some researchers of Caspian Depression are trying to conduct such a correlation. Thus, one of the papers presented at the Third International geological conference "Atyrau-Geo-2015" has a teaser headline "Caspian Depression as part of Ural geodynamic system" (Jurish & Ulukpanov, 2015). The title of the report is a little bit shocking, as well as its content. Authors of the report attempt to explain the nature of geodynamical formation of the sedimentary cover of the Caspian Depression not even by the opening of a large hypothetical Paleo-Uralian ocean, but by its closing.

"After the completion of spreading in the Silurian-Lower Devonian, the expansion of the oceanic crust thickness and the related change of volcanism phases, the formation of the first layer of the oceanic crust occur in the Middle Devonian-early Upper Devonian period. The bottom of Paleo-Uralian Ocean represents a rigid plate in the Frasnian. The period of Upper Devonian (Famennian) – Lower Carboniferous is a period of intense geodynamical activation: the beginning and the activation of convergence of Russian and Siberian continents and closing of the Paleo-Uralian Ocean. On the western and eastern borders of the Paleo-Uralian Ocean Benioff–Wadati zones are being formed (subduction zones).

Western carbonic subduction zone, *where the Caspian Depression originated*, was formed as squeeze basin at the junction of the oceanic and continental plates. Hain V. E. notes that, "such squeeze of *small ocean basins* do not always lead to their total collapse, and they remain as a relict basin of this type, usually filling with thick layers of sediment". During the Famennian-Carboniferous and Permian, the sequence of terrigenous fluschoid rocks had accumulated with thickness of more than 5 km, burying juncture commissure of oceanic plate with Russian Platform" (Jurish & Ulukpanov, 2015).

It is understood that the position of such representations eliminates the formation of the platform cover of the Caspian Depression. A rounded syneclise could not be formed alongside elongated attributes of a large hypothetical Paleozoic ocean, abovementioned by authors as Uralian (Ural-Tien Shan) paleo-ocean. Isometric configuration of syneclise in the plan, continuality of the section of the Phanerozoic (Neoproterozoic- Phanerozoic) cover deposits, weak dislocation of this complex as a whole are clear signs of a long-term squeezing this area, rather than expanding.

The results of research made by group of Kazakh scientists on Paleozoic ophiolitic zones within the exposed part of the Kazakh folded region of Central Asian Orogenic Belt showed that great ocean did not exist in the Paleozoic (Neoproterozoic-Paleozoic) stage of development of the planet. At the time, plate tectonics "worked" on the regional scale opening and closing "micro-oceans" (Seitov, 2008a, 2008b). This conclusion has been made in result of studying spatial distribution, age of ophiolites, features of the internal structure of twelve ophiolite zones of Paleozoic and embedded rocks formation types. These structures are the only true indicator of existence of oceanic crust (the lithosphere) in the Paleozoic (Neoproterozoic-Paleozoic), "randomly scattered" throughout the territory of the Kazakh folded region in the form of structural and formational zones (width of several tens of km, length of a hundreds km). At the same time, these areas differently oriented in space, have different age of deposit and

development, and despite regional dimension, they are characterized by a complete set of fragments of geological formations. These formations are peculiar both the ocean opening stage (formations fragments of continental rifting and passive continental margins and ophiolite assemblage of rocks), and closing stage (fragments of island-arc formations, formations of marginal seas, etc.). Moreover, large arrays and small blocks of Precambrian formations, which are fragments of a mature continental crust (lithosphere) are commonly found among differently oriented Paleozoic ophiolite zones.

Represented data indicate that the conduction of tectonic zonation and determination of geodynamical nature of the formation of structures of the earth's crust of Precambrian-Paleozoic age (including the platform cover of Caspian Depression and folded basement epi-Paleozoic Turan (Scythian-Turan) plate) are wrong from the position of global plate tectonics.

The second structure referring the North Caspian, and considered in this article is the northern edge of epi-Paleozoic Turan plate, distinguished by Kazakh oil geologists as "Bozashinsk diastrophism system" (Marabaev et al., 2005). According to these authors, the Bozashinsk diastrophism system spacely corresponds to the "North-Caspian uplift in the Paleozoic", which borders with southern edge of Caspian ancient platform in the form of a relatively narrow strip (of width 60-100 km), as it was mentioned above, south-eastern bearing line. The authors disjointed this system of Paleozoic folding in by cross (from north-west to south-east) on the three structures - Makhambet overthrust belt, the central zone of the North-Caspian uplift and Khazar overthrust belt (Marabaev et al., 2005). At the same time, the Paleozoic formations of Makhambet overthrust belt on fault plane are thrust over the southern side of the Caspian Depression. Khazar overthrust belt is southernmost structure of North Caspian uplift limiting Bozashinsk diastrophism system from the Central-Mangyshlak trough, which is related to "Mangyshlak diastrophism system" of the Middle Caspian (Marabaev et al., 2005).

As for the geodynamical nature of structures relating to Bozashinsk diastrophism system (North Caspian uplift in the Paleozoic), Turan (Scythian- Turan) young plate is a typical representative of the combination of these structures, as the main part of the Paleozoic complex is heavily dislocated in its section (up to early Permian) and represents folded basement of young platform. Two structural level are distinguished: an intermediate level (Lower Permian- Upper Triassic deposits) and platform cover. The intermediate structural level lies down on basement rocks with a sharp angular displacement and cover rocks discordantly superpose it. The lower part of platform cover section (period from Jurassic to Miocene) is commercially oil-bearing (Seitov & Arshamov, 2015). The degree of dislocation of sequences in the intermediate level is not comparable with the degree of dislocation of complexes in folded basement. Complexes of platform cover lie horizontally, or form structures with slightly sloping angles, usually not exceeding 1-5°.

Discussion and Conclusion

Some researchers of Turan (Scythian-Turan) young plate believes that the deformation of the plate's folded basement played a crusial role in the closing of so-called Paleo-Tethys, while the formation of the sedimentary cover is connected with the opening of Meso-Tethys, on the contrary. We agree with the second part of this idea, because the

sequences of the Mesozoic-Cenozoic cover of Scythian-Turan plate could be really deposited in a passive margin of Meso-Tethys, which has extensive (large) size. Scythian-Turan plate stretches as narrow band from the south-east to north-west between the East European Craton in the north and mountain structures of Alpine folding in the south (the Carpathians, the Caucasus Mountains, the Pamir Mountains, the Hindu Kush etc.). Strong deformation of the Paleozoic folded basement of the platform can be hardly explained by the closing of the supposed Paleo-Tethys, which had the same size. Ancient ocean Paleo-Tethys might be not a large ocean, but a group of several small oceans (micro-oceans), stretching in subparallel to the southern border of the East European Craton (Troickij, 2011). Thus, according to the research of the author, three microcontinents and three micro-oceans intersperses from north to south: Mid-Tien Shan microcontinent; Turkestan paleo-ocean; Alay microcontinent; Zeravshan paleo-ocean or northern Paleo-Tethys; Afghan-Tadjik microcontinent; South Paleo-Tethys. These conclusions are made based on the results of the study of folded structures of the Eastern (Asian) part of Paleo-Tethys, although a similar pattern can be observed with the detailed study of features of the geological structure of the south of the European continent, in particular, within the Caucasus Mountains. However, under the “paleo-ocean” we mean oceanic crust (lithosphere), rather than the space occupied by ocean water. Accordingly, abovementioned microcontinents and paleo-oceans could be found within a single watershed, but they would differ from each other by hypsometric marks and type of crust (lithosphere).

Implications and Recommendations

The content of the above discussion shows that the geodynamical (tectonic) nature of the Caspian Depression should be mainly considered as a purely continental ancient structure, in the formation of which there is no role of plate tectonics. Global plate tectonics since the Mesozoic time and Meso-Tethys opening played a decisive role in the formation of Turan (Scythian-Turan) young plate and, consequently, of the North Caspian uplift (Bozashinsk diastrophism system). It furthered the deposition of thick terrigenous rock sequences of sedimentary cover of young platform on a passive margin of Meso-Tethys. The reason for the deformation of the Paleozoic (Precambrian-Paleozoic) foundation of this platform should probably be explained not by closing of great Paleo-Tethys, but by opening and closing of Paleozoic micro-oceans with east-west trending, which intersperse with microcontinents with mature continental crust.

Disclosure statement

No potential conflict of interest was reported by the authors.

Notes on contributors

Nassipkali Seitov is a Doctor of Geological-Mineralogy Sciences, Professor of the Geologies Survey Exploration of Mineral Resources Department, Kazakh National Research Technical University after K. I. Satpayev, Almaty, Kazakhstan.

Gulmira P. Tulegenova holds a Master Degree, Doctoral Candidate at the Geologies Survey Exploration of Mineral Resources Department, Kazakh National Research Technical University after K. I. Satpayev, Almaty, Kazakhstan.

References

Ajzenshtdat, G. E.-A. et al. (1967). Oil and gas sequences of the Caspian Depression. *Proceedings of VNIGRI*, *Moscow: Nedra*, vol. 253.

Amelin, N. V. et al. (2015). Modern approach to the study of deep geological structure, tectonics and geodynamics of the crust of the Caspian Sea sedimentary basin. *Proceedings of the Third International Scientific Geological Conference Atyrau-Geo-2015. Atyrau,* 54-57.

Antipov, M. P. et al. (2015). Nature of oil-and-gas localizing objects of tasymov type (Aktobe-Astrakhan elevation zone. *Proceedings of the Third International Scientific Geological Conference Atyrau-Geo-2015*. *Atyrau,* 37-40.

Avdeev, A. V. (1984). Ophiolitic zones and the geological history of the territory of Kazakhstan. *Soviet Geology, 4*, 63-72.

Avrov, P. Ja. et al. (1962). Geological structure and oil-and-gas content potential of the eastern and south-eastern edges of the Caspian Depression. In *Geology and oil-and-gas content of eastern part of the Caspian Depression and its edges*. Gostoptehizdat.

Bulat, P. V. (2016). The History of the Study of Shock Wave's Mach Reflection from the Wedge. *IEJME-Mathematics Education, 11*(5), 1151-1162.

Bulekbaev, Z. et al. (1967). Carboniferous and Lower Permian deposits of eastern cutoff part of the Caspian Depression. *Bulletin of MOIP, Geology department, Vol. 42.*

Daukeev, S. Zh. et al. (2002). Deep structure and mineral resources of Kazakhstan. *Oil & Gas, 3*, 248-251.

Gareckij, R. G. et al. (1962). Deep structure of South-Emba region gravitational maximum in relation of the latest geological and geophysical data. In *Geology and oil-and-gas content of eastern part of the Caspian Depression and its edges.* Gostoptehizdat.

Hain, V. E., & Lobkovskij, L. I. (1990). On peculiarities of formation of collisional orogens. *Geotectonics, 6,* 20-32.

Jurish, V. V., & Ulukpanov, K. T. (2015). Caspian Depression as part of Ural geodynamic system. *Proceedings of the Third International Scientific Geological Conference Atyrau-Geo-2015. Atyrau,* 68-71.

Kuandykov, B. M., & Matloshinskij, N. G. (2015). New prospects of oil-and-gas content in Paleozoic shelf margin of the north of the Caspian Depression. *Proceedings of the Third International Scientific Geological Conference Atyrau-Geo-2015. Atyrau*, 32-36.

Kunin, N. Ja., & Sopozhnikov, R. B. (1964). Tectonics and oil-and-gas content prospects of Paleozoic sediments area of South Emba gravitational maximum based on the results of the geophysical research. *Oil & Gas Geology, 4*.

Kusanov, Zh. K. (2015). Oil-and-gas content at great depths of the Caspian basin from the perspective of the theory of stylolites formation. *Proceedings of the Third International Scientific Geological Conference Atyrau-Geo-2015. Atyrau*, 84-87.

Marabaev, Zh. N., Zholtaev, G. Zh. et al. (2005). *Geological structure and oil-and-gas content prospects of the North and Middle Caspian.* Astana.

Murzin, Sh. M. (2010). *Geological structure and oil-and-gas content prospects of the North and Middle Caspian:* PhD abstract. Moscow, 36 p.

Nursultanova, S. A. (2003). *Tectonic-sedimentary structure model and oil-and-gas content of pre-Jurassic deposits of the junction zone of the Caspian Depression with a Scythian-Turan plate*: PhD abstract. Almaty, 34 p.

Pilifosov, V. M., Vocalevskij, Je. S., & Vasil'ev, B. A. (1996). Tectonics of the junction area of the Caspian Depression and the North Ustyurt. *Geology of Kazakhstan, 1,* 66-78.

Seitov, N. (2008a). *Genetic and Geodynamic Nature of the Paleozoic Ophiolite ures and their Surrounds from a Position of the Paleozoic Struct Regional Small Plate Tectonics*: Abstract CD-ROM. 33rd International Geological Congress. Oslo, Norway.

Seitov, N. (2008b). *Paleozoic regional tectonics of minor plates and its base*: Abstract CD-ROM. 33rd International Geological Congress. Oslo, Norway.

Seitov, N., & Arshamov, Ja. K. (2015). *Regional geology*. Almaty.

Troickij, V. I. (2011). Geodynamics and evolution of the Paleozoic fold systems and Asian paleo-ocean Paleo-Tethys in Central Asia. *Proceedings of the International Conference dedicated to the memory of V. E. Khain "The current state of the Earth sciences". Moscow,* 1898-1904.

Zholtaev, G. Zh., & Kuandykov, B. M. (1999). Geodynamic model of the structure of the south of Eurasia. *Oil & Gas, 2*, 62-74.

Zonenshajn, L. P., Kuz'min, M. I., & Natapov, L. M. (1990). *Plate tectonics in the territory of USSR* (Vol. 1). Moscow: Nedra.